Value Pricing Roadways

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Abstract

Traditional congestion pricing strategies are meant to reduce demand on heavily congested roads by charging every user a toll during times when the facility experiences congestion. Value pricing refers to the practice of requiring drivers to pay the right toll for the first class service of a guaranteed congestion-free lane. This article describes the successful implementation of four such programs launched in California and Texas: State Route-91 in Orange County, CA, I-15 in San Diego, CA, and the I-10 Katy Freeway and US 290 Northwest Freeway in Houston, TX. The article also describes a current ongoing effort to research value pricing projects in North Carolina.

Introduction

Traditional congestion pricing strategies are intended to reduce demand on heavily congested roads by charging every user a toll during times when the facility experiences congestion.

When properly implemented, High Occupancy Toll (HOT) lanes provide a less congested lane, which helps reduce travel time and increase driving ease. Such schemes are intended to better balance the private benefits of automobile use with its social and environmental costs. Research shows that congestion pricing can serve to persuade people to carpool, vary the times they travel, alter their routes, choose other destinations, change the departure time and avoid or combine trips (TRB, 1994). In several cases, value pricing has been applied to High Occupancy Vehicle (HOV) lanes in order to increase their usage and the overall throughput on the roadway without reducing the incentive to rideshare.

Four original HOT lane facilities are currently in operation. These include SR-91 in Orange County California, I-15 in San Diego, and the I-10 Katy Freeway and US 290 Northwest Freeway in Houston. This article describes the successful implementation of each of these four projects and describes a current ongoing effort to research the feasibility of a value pricing project along I-40 in North Carolina.

Legal Authority for Value Pricing

Legal authority for exemplary projects is provided at the Federal level by the Value Pricing Program included by Congress in the 1998 TEA-21 legislation. In reauthorizing the program (originally specified in the ISTEA legislation of 1991) as a pilot program, Congress recognized value pricing as a new and innovative approach to congestion relief and noted the need to for

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more information on its effectiveness in different urban settings. Both technical and financial support is provided to support state and local efforts to plan, implement, manage, evaluate, and report on value pricing initiatives (FHWA, 1998). State legislation may be needed, for one or more of the following: (1) to permit conversion of existing HOV lanes to HOT lanes, (2) to permit charging a fee to use a state highway, and (3) to permit enforcement via video and electronic means.

The implemer.tation of a value pricing program may entail numerous benefits and costs, as described in the next sections.

Benefits of Value Pricing

Reduced congestion in general purpose lanes—The impact of HOT lanes upon traffic congestion will differ depending on local conditions, particularly the level of latent demand and the availability of alternate routes.

Overall optimization of facility usage—Value pricing lane projects have resulted in overall improvements in speed and throughput. Value pricing spreads peak demand over a longer period, thereby smoothing the flow of traffic. A shift in a relatively small proportion of peak-period trips can lead to substantial reductions in overall congestion.

Easily fine-tuned user charges preserve free flow conditions—Under value pricing, user charges are set at a level that is expected to produce the desired effect of congestion relief while maintaining sufficient usage of the facility (Hyman and Mayhew, 2002). Variable pricing based on time of day (SR-91) or both time of day and volume has proven effective in shifting demand and maintaining free flow on the value priced lanes.

Reduction of new construction in conversion of existing HOV lanes—Conversion of existing HOV lanes to HOT lanes requires much less road infrastructure investment than building to meet demand, by using existing capacity more efficiently.

Provision of a less congested path for transit and emergency vehicles—Under value pricing, transit vehicles gain access to a faster-moving lane, giving them a competitive advantage over auto use in the regular lanes. This possibly may lead to a shift in travel mode choice, away from the automobile and toward public transit. Emergency services benefit from the implementation of value pricing, as it allows them access to a less congested path.

Additional revenue to pay for transportation improvements—Experience shows that HOT lanes are capable of providing adequate revenue to fund operations, and possibly pay for a portion of capital expenses. The Inland Breeze bus service along San Diego's I-15 exemplifies how HOT lanes can generate revenue to improve alternate modes of transportation.

Reduction of harmful externalities—Improved traffic flow reduces air pollution, incidents, noise levels, and fuel consumption.

Costs relating to Value Pricing

Significant investment in technology—Toll infrastructure requires significant up-front investment in electronic equipment, communications, accounting software and personnel, public information, and management.

Enforcement—Enforcement is needed at each entrance and exit point. Camera enforcement is the only safe

and cost-effective method of addressing toll violations under current conditions.

However, if carpools were allowed to use the facility for free or at a discount, manual "credit" would need to be provided via a manned facility at some location in the corridor because camera technology does not exist for accurately determining the number of persons in a vehicle.

Safety concerns—Implementation of HOT lanes without barrier separation may pose a safety hazard, as it results in more traffic in the inside lane and increases the propensity of drivers to weave in and out of lanes at will. Concrete barriers help to improve safety by eliminating random ingress/egress problems but may also limit access by police and emergency vehicles.

Political opposition to tolls or variable pricing—Those seeking to implement value pricing policies often encounter intense political opposition, as the policy adds a price to something that was previously regarded as a free good (Hau, 1992).

Equity—One major concern surrounding HOT lanes is that lower income populations will not be able to afford to use these lanes.

An Overview of New Projects

A list of current value pricing projects is presented in Table 1 on the following page. In addition to traditional HOT lanes, other concepts being demonstrated include "cordon tolls," which are charged when vehicles enter the perimeter of a restricted area. In addition, "fair lanes" are HOT lanes that include a method of income transfer to make the tolled lanes available to people who have low incomes. Also included are existing facilities with congestion pricing variations in the toll rate. Usage-based tolls are based on the distance traveled.

Existing HOT Lane Projects

Currently, HOT lanes are in operation in four areas around the United States. The following section provides a description of each.

State Route-91, Orange County, CA

The State Route-91 Express Lanes project added four new lanes for ten miles to the wide median of the Riverside Freeway at a total capital cost of $130 million (see Figure 1). The project is unique because it was

Figure 1. Map of State Route-91. *Source: A Guide for HOT Lane Development (Perez, 2003).*

Existing Projects	*SR-91*	*I-15*	*I-10 (Katy Highway)*	*US 290 (Northwest Freeway)*
Region	Orange County, CA	San Diego, CA	Houston, TX	Houston, TX
Authority	CalTrans	SANDAG	Houston Metro, TxDOT	Houston Metro, TxDOT
Number of Miles	10	8	13	13.5
Additional Lanes Built	4 new lanes	no	no	no
HOV Conversion	no	yes	yes	yes
Name of HOT Lane Project	ExpressLanes	FasTrak	QuickRide	QuickRide
Date HOT Lane Project Started	1995	1997	1998	2000
Design of HOT Lanes	2 HOT lanes in each direction, fully separated in the median; only one access point at each end: functions as a pipeline	1 HOT Lane in each direction	1 lane reversible flow facility, five access points	1 lane barrier separated reversible flow facility
Lane Capacity	1800veh/hour/lane		1500veh/hour/lane	6400veh/day
Tolling Structure	Discounted tolls for 3+ carpools, zero emissions vehicles, motorcycles, disabled, veterans	2+ carpools ride free, SOV pay toll	2+ carpools may pay to use the lane when the 3+ HOV is in effect, no SOV	3+ carpools ride free, 2+ pay toll
ATI	fully automated; must have FasTrak Transponder	fully automated; must have FasTrak Transponder	fully automated, Harris County Toll Road Authority QuickRide transponders	fully automated, Harris County Toll Road Authority QuickRide transponders
Cost of Project	$134 million; private toll venture, financed by CPTC	$7.96 million from FHWA Value Pricing Pilot Program		
Use of Proceeds	ROI to CPTC	transit service in the corridor (Inland Breeze peak-period express bus)		
Expansion Plans	n/a	extend I-15 HOT lanes, creating a 20 mile, reversible flow managed lane	possiblity of major expansion, HCTRA has offered $250 million to finance construction of Katy special use lanes	n/a

Table 1. Current value pricing roadway projects.

the result of a franchise agreement that was signed between CalTrans and the California Private Transportation Corporation (CPTC) in 1990 for construction, operation, and maintenance of two ten-mile toll lanes.

Demand for congestion relief in this corridor was so strong that the company announced the project had paid for itself by the end of its third year in 1998. In other words, toll revenues paid by drivers choosing to use the HOT lanes rather than the adjacent regular lanes are now high enough to cover the project's annual debt service as well as all operating and maintenance costs, with at least the beginnings of a profit to the company.

An extensive four-year study by CalTrans and the U.S. Department of Transportation (USDOT) evaluated the impacts of the variable-toll express lanes, exploring overall changes in traffic and travel behavior, vehicle occupancy, traveler demographics, alternative travel modes, operations and safety, and public opinions.

The resulting research shows that the express lanes provided an average time savings of nearly 13 minutes. Other perceived benefits include increased reliability, greater safety, and better predictability (Poole and Orski 2002). It was found that about 20 percent of commuters in each income category used the HOT lanes, suggesting that income is unrelated to whether persons changed their ridesharing behavior after the toll lanes opened. Those commuting to work are more likely to travel in the HOV lane than in the Single Occupancy Vehicle (SOV) lanes. Roughly 75 percent of HOV-3 work commuters report to be frequent toll lane users as compared to 26 percent and 16 percent, respectively, for non-work-related HOV-3 and SOV users (ARDFA, 1998).

The research also shows that there was no significant association between the opening of the managed lanes on SR-91 and changes in the HOV traffic on SR-57/60 freeway corridor 15 miles to the north. Thus, the toll lane exerted a local influence but did not affect traveler route shifts at the regional scale.

Interstate-15, San Diego, CA

In 1988, two underutilized HOV lanes were converted to reversible HOT lanes along I-15 in San Diego, CA, and overseen by a toll authority. The system consists of two reversible lanes constructed along an eight-mile stretch of I-15 (see Figure 2). The program was initially proposed by the San Diego Association of Governments (SANDAG). Nearly $8 million of Federal funding from the USDOT's Value Pricing Pilot Program was provided, matched by $2 million from the state to implement first a permit system on the lanes. The FasTrak Electronic Toll Collection (ETC) system was installed, which charged users of the HOT lane a per-trip toll based on congestion levels. Tolls range between $0.50 during non-peak times and $8.00 during levels of severe congestion. Electronic signs placed in front of HOT lane entrances provide advance notice of the toll.

Figure 2. Map of Interstate-15. *Source: A Guide for HOT Lane Development (Perez, 2003).*

Daily traffic volumes on the express lanes averaged 18,500 vehicles in November 2001, a 102 percent increase from the pre-project level of 9,200, while still maintaining the desired high level of service. Under worst traffic conditions, FasTrak users save about 20 minutes of delay over the ten-mile corridor (DeCorla-Souza, 2002).

The typical HOT lane user was a middle-aged female of high income, highly educated, and from a household with two or more vehicles. An important feature of the I-15 lanes is that carpooling increased since the conversion of the HOV lanes, despite fears that the HOT option would discourage carpooling (Poole and Orski, 2002).

The project is self-sufficient, with the conversion requiring $1.85 million in capital costs (not including the transponders paid for by individual drivers), and is generating revenue at the rate of approximately $1 million per year.

Interstate-10 Katy Freeway and the US Route-290, Northwest Freeway, Houston, TX

In 1998, a 13-mile HOV lane along a central artery of western Houston was converted into a single, reversible HOT lane (see Figure 3). Designed to carry 79,200 vehicles per day, the Katy Freeway now carries over 207,000 vehicles per day, and it is considered one of the most congested stretches of freeway in Texas. Congestion may be present for 11 hours or more each day. Some estimates place the cost of the Katy's traffic delays to commuters, residents and businesses, at $85 million a year.

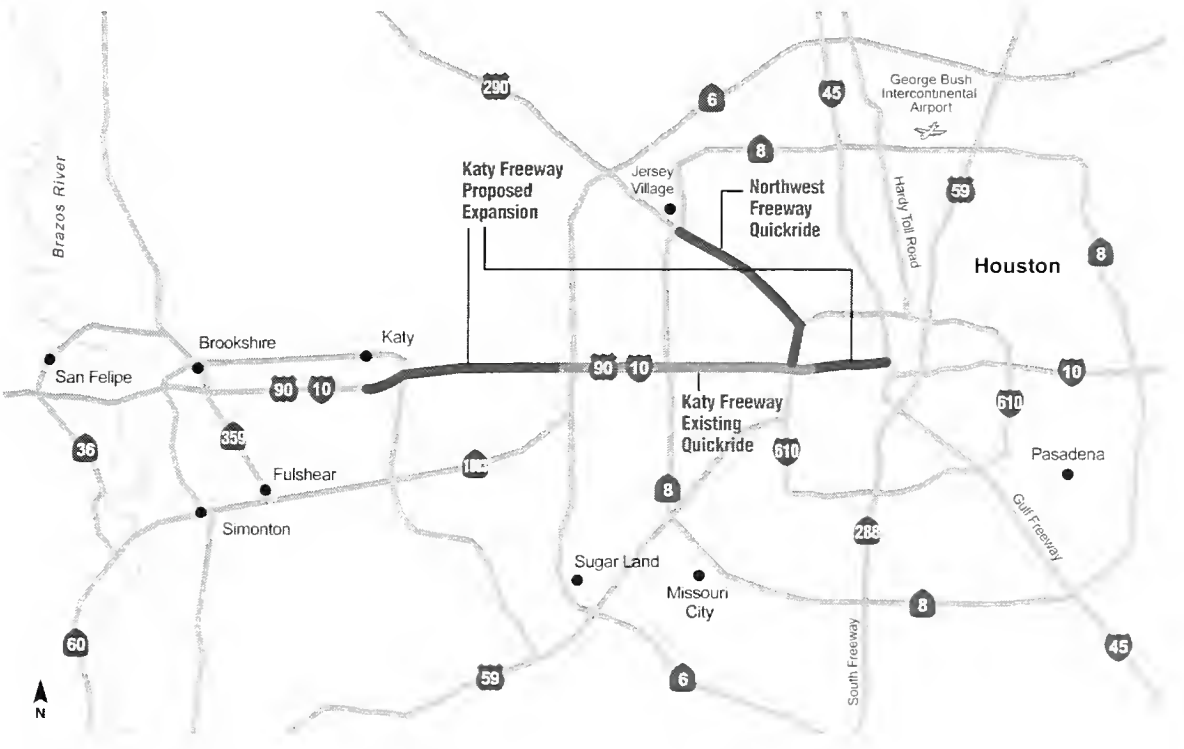

Figure 3. Map of Interstate-10 and U.S. Route-290. *Source: A Guide for HOT Lane Development (Perez, 2003).*

As currently configured, the Katy Freeway has three general-purpose lanes and two frontage-road lanes for most of its length in each direction. Situated in the center of the freeway is a barrier-separated High Occupancy Vehicle/Toll lane for carpools and buses, making a total of 11 through lanes. A single reversible lane, the HOT facility handles inbound traffic in the morning and outbound traffic in the evening.

When the Katy HOV lane first began operating, only buses and authorized vanpools were allowed to use it. The resulting underutilization gradually encouraged a loosening of the HOV entry rules: gradually, registered carpools of HOV-4, then HOV-3, then HOV-2 were allowed into the lane. (HOV-4, -3 and -2 refer to lanes requiring a minimum of four, three, and two passengers, respectively.) As restrictions were relaxed, traffic grew, and more restrictive carpool rules were eventually reinstated to HOV-3 at peak hours. With two-person carpools no longer allowed, the number of persons moved by the lane during peak hours declined 30 percent.

Most of the HOV lane users are commuters who formerly used the general-purpose lanes (Poole and Orski, 2002). Before and after studies of the Katy Freeway showed that its HOT lane application had the following positive results:

- The number of 3+ carpools increased during the peak;
- 2+ carpools redistributed to before and after the peak hour;
- Average traffic speeds increased and the HOV's level of service improved; and
- The same number of passengers was transported more efficiently.

While the evolution of the QuickRide system is a useful case study in itself, the number of paying users that these two facilities could accommodate is limited. Expansion plans for the Katy Freeway are currently under consideration and could significantly increase the scale and scope of HOT lane operations in the Katy Corridor.

The I-40 Project in North Carolina

In August of 2004, a team of researchers and engineers began investigating the feasibility of an HOT lane along I-40 in North Carolina. The research effort has been supported by funding from the North Carolina Department of Transportation (NCDOT) and the Federal Highway Administration (FHWA). The project team consisted of professors from NC A&T State University, UNC-Chapel Hill, and the director of the Piedmont Authority for Regional Transportation.

The team is researching the feasibility of a reversible, managed lane (eastbound in the morning and westbound in the evening) along I-40. The lane will be separated from the general-purpose lanes by candlestick markers. Drivers can use the lane for free if their car is HOV-3, or they can pay a toll. The toll will vary by the time of day so that there will be a higher toll during rush hour. The toll will be collected automatically so that there will be no tollbooths.

Figure 4 shows how the managed lane may appear once it is built. Figure 5 presents a map of where the managed lane is planned, between the I-40 Business and I-40 interchange, and where I-40 and I-85 merge.

Researchers are currently collecting survey data on the opinions of commuters living in close proximity to the proposed HOT lane. The researchers are also survey-

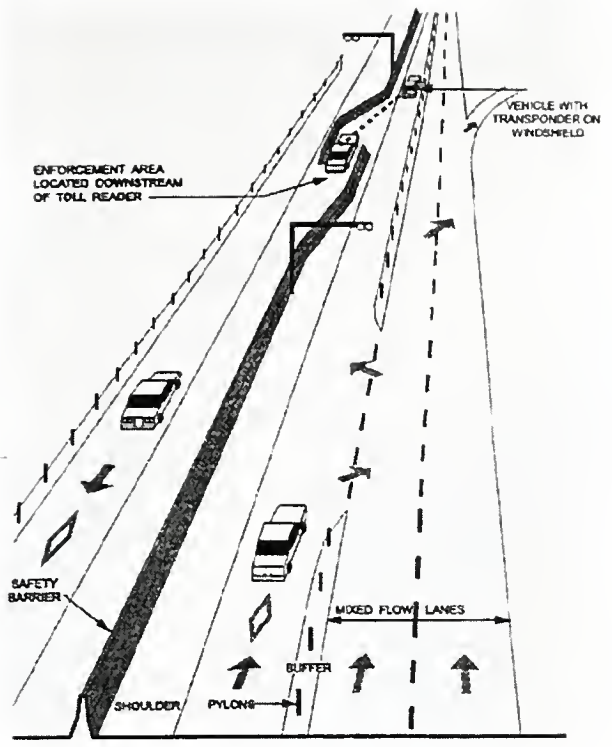

Figure 4. Sketch of possible design for HOT lane on I-40. *Source: Parsons Brinkerhoff, 1998.*

ing stakeholders in the project to determine their level of support for the project. The questions of both studies deal with the concept of using managed lanes for value pricing. This abstract approach was necessary because state legislation has not yet been adopted to support this form of tolling and enforcement. Suggestions for such legislation will be one outcome of the overall study.

Other Value Pricing Projects

The second stage of value pricing is underway either in the planning or implementation stage. Newly implemented projects include congestion tolls on Port Authority bridges and tunnels between New York and New Jersey and the Florida barrier island value pricing project. Value pricing lanes are also planned for Minnesota. Other plans have been investigated for Maryland. There are additional plans to expand the

Figure 5. Location of possible HOT lane on I-40. *Image adapted from NCDOT Strategic Highway Corridor Map.*

existing small, eight-mile project to regional HOT lane networks. There have even been sketch plan proposals for HOT lane systems in the twenty largest American cities.

Concluding Remarks

In recent years, value pricing has become a frequently used element of design in areas of the United States that experience congestion, as it promises to encourage ride-sharing and higher occupancy rates while providing drivers the option of avoiding traffic bottlenecks.

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